

Application of Suomi-NPP Green Vegetation Fraction and NUCAPS for Improving Regional Numerical Weather Prediction

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The NASA SPoRT Center is working to incorporate Suomi-NPP products into its research and transition activities to improve regional numerical weather prediction (NWP). Specifically, SPoRT seeks to utilize two data products from NOAA/NESDIS: (1) daily global VIIRS green vegetation fraction (GVF), and (2) NOAA Unique CrIS and ATMS Processing System (NUCAPS) temperature and moisture retrieved profiles. The goal of (1) is to improve the representation of vegetation in the Noah land surface model (LSM) over existing climatological GVF datasets in order to improve the land-atmosphere energy exchanges in NWP models and produce better temperature, moisture, and precipitation forecasts. The goal of (2) is to assimilate NUCAPS retrieved profiles into the Gridpoint Statistical Interpolation (GSI) data assimilation system to assess the impact on a summer pre-frontal convection case.

Most regional NWP applications make use of a monthly GVF climatology for use in the Noah LSM within the Weather Research and Forecasting (WRF) model. The GVF partitions incoming energy into direct surface heating/evaporation over bare soil versus evapotranspiration processes over vegetated surfaces. Misrepresentations of the fractional coverage of vegetation during anomalous weather/climate regimes (e.g., early/late bloom or freeze; drought) can lead to poor NWP model results when land-atmosphere feedback is important. SPoRT has been producing a daily MODIS GVF product based on the University of Wisconsin Direct Broadcast swaths of Normalized Difference Vegetation Index (NDVI). While positive impacts have been demonstrated in the WRF model for some cases, the reflectances composing these NDVI do not correct for atmospheric aerosols nor satellite view angle, resulting in temporal noisiness at certain locations (especially heavy vegetation). The method behind the NESDIS VIIRS GVF is expected to alleviate the issues seen in the MODIS GVF real-time product, thereby offering a higher-quality dataset for modeling applications. SPoRT is evaluating the VIIRS GVF data against the MODIS real-time and climatology GVF in both WRF and the NASA Land Information System.

SPoRT has a history of assimilating hyperspectral infrared retrieved profiles into GSI/WRF for regional modeling studies. Although hyperspectral infrared sounder radiance data are assimilated into global operational modeling systems, assimilated data are limited due to data thinning and because radiances are restricted to cloud-free fields of view. The number of hyperspectral infrared profiles assimilated is much higher since the retrieved profiles can be assimilated in some partly cloudy scenes due to profile coupling other data (e.g., microwave or neural networks) as first guesses into the retrieval process. Additionally, radiance assimilation in regional models involves complex bias corrections; therefore, the use of retrieved profiles may be less complex and more computationally efficient for regional modeling. For this project, NUCAPS temperature and moisture retrieved profiles are being assimilated to assess the impact on regional modeling studies. The 13-km Rapid Refresh is used to initialize the model using a configuration similar to the High Resolution Rapid Refresh. Preliminary results show the impact of NUCAPS profiles on temperature and moisture analysis fields and WRF model output.